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Period Covered: 1 July 1973 to 31 August 1973

Title: A Scheme for the Uniform Mapping and Monitoring of Earth Resources and Environmental Complexes Using ERTS-1 Imagery

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OBJECTIVES

To develop, test and specify a practical procedure and system for the uniform mapping and monitoring of natural ecosystems and environmental complexes from space-acquired imagery. A uniform ecological legend system is to be fully developed for use as a standard format for making natural resource inventories.

Also, space imagery will be analyzed for its usefulness in estimating crop yield in the rice growing areas of California and Louisiana.

MAJOR ACCOMPLISHMENTS

Natural Vegetation Analog Studies

1. Thirty-two ERTS frames covering the Sierra-Lahontan and Colorado Plateau test area on different dates were color reconstituted on the I^2S Additive Color Viewer. The following filter and lamp intensity combinations were determined to give maximum differentiation of Earth surface features:

band 4-blue filter-illumination setting of 7.0: band 5-green filter-illumination setting of 7.5: band 7-red filter-illumination setting of 7.5.

All of these reconstituted frames were copied on tungsten corrected EHB-120 film. Variable camera extension tube and exposure combinations were attempted to obtain maximum retention of original details and to determine the best scale to work with in future experiments. A reduction to .51X exposed for 4 seconds was determined to be optimum for our purposes.

Two critical seasons of cloud-free ERTS imagery are available for the inter-regional aspect of our study. These dates are for spring time May 18 and 19, 1973 for the Colorado Plateau and May 26, 27, and 28, 1973 (Sierra-Lahontan). For late summer the dates are September 26 and 27, 1972 for the Colorado Plateau and September 16, 17, and 18, 1972 for the Sierra-Lahontan.

2. Large-scale color and color infrared photographs and ground truth data were collected during the week of August 6, 1973 in the Colorado Plateau by the EarthSat project aircraft.

3. Cooperating U.S. Forest Service and B.I.A. personnel in Colorado collected valuable phenological notes and photographs of the region. Forest and range vegetation type maps were obtained from both agencies.

4. U-2 and large-scale imagery of both test areas was used along with ground truth data and the existing vegetation maps to select over 200 analog sites in each test area.

5. Phenological patterns of major vegetation types have been monitored. The inter-regional vegetation analogs that have been monitored to date include: (1) salt desert vegetation, (2) big sagebrush shrublands, (3) pinyon pine-juniper woodlands, (4) ponderosa pine (Colorado Plateau site) and Jeffrey pine (Sierra-Lahontan site) forests, and (5) aspen stands.

To determine dates of vegetation development that are as close to being equal in both regions as is possible, a survey of snowfall and snowmelt patterns was conducted in both regions. For each date available in cloud-free ERTS coverage a series of random sites were selected to measure the elevation of seasonal snowpack. Since the entire growing season of montane, subalpine and alpine vegetation is closely tied to the amount of time available for vegetative growth following snowmelt, snowmelt patterns are important to understand phenological development of plant communities. The following graphs show snowmelt patterns for both test sites as plotted from multidate ERTS coverage.

On Graph II a figure of 5000 feet for any date indicates that snow covered the entire area and, therefore, cannot be used as the boundary elevation for the seasonal snowpack. All other figures represent actual average snowline positions as observed on ERTS.

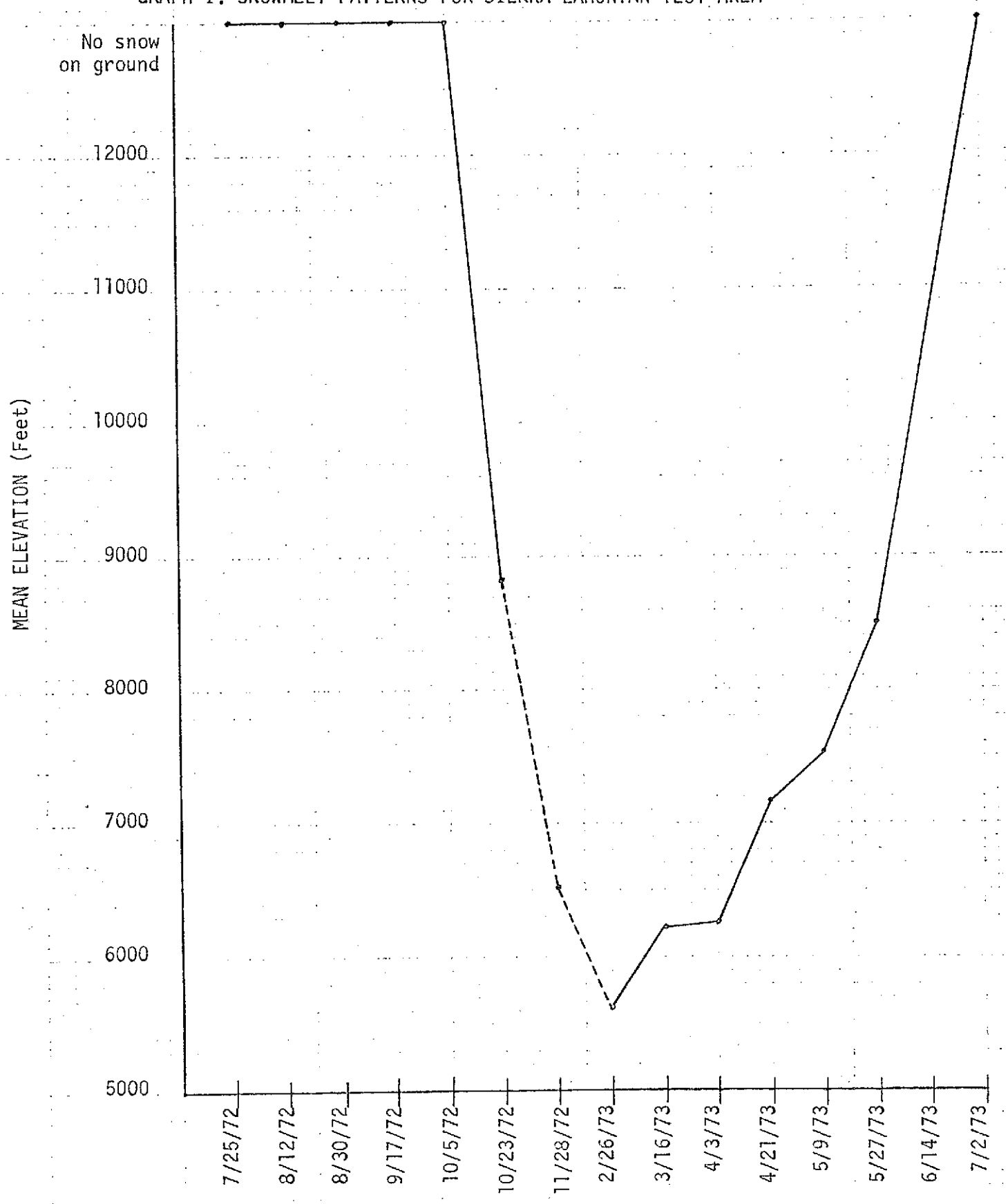
6. A preliminary mapping job was accomplished on a color reconstituted 9"x9" print of a section of the Colorado Plateau test area (27 September 1972, #1066-17251). Broad vegetation types were outlined to give an idea of the amount of detail discernible on small-scale (1:1,000,000) ERTS imagery. Figure 1 shows the boundaries as they were drawn on the color print.

The following preliminary quaternary level legend symbols as identified on Figure 1 represent various vegetation types:

130 - alpine rocklands which exhibit a distinctive arctic-alpine flora.

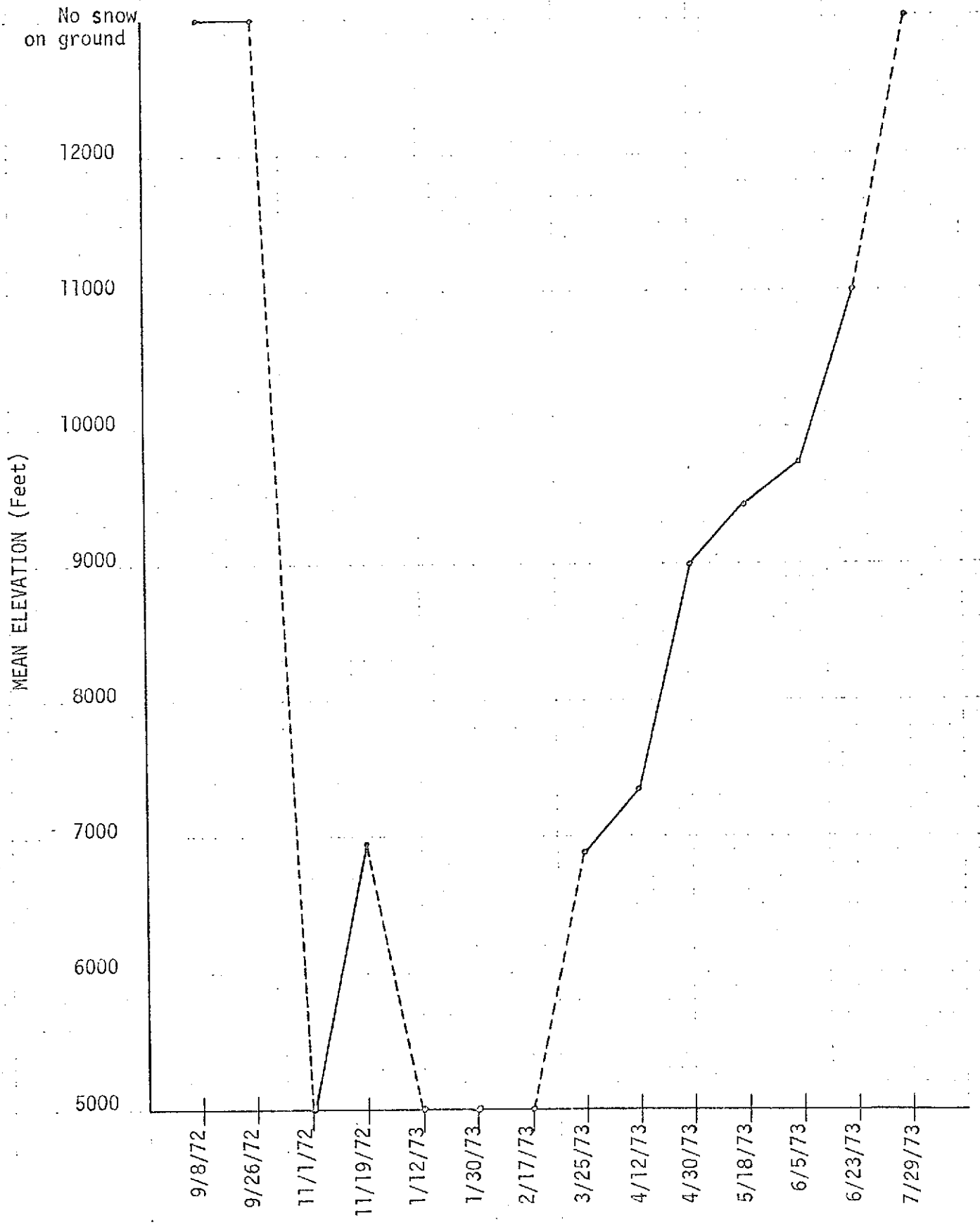
324.3 - salt desert vegetation dominated by various species of Atriplex (saltbush), Hilaria jamesii, and other semidesert species. Several subtypes are recognizable on this imagery but are too small to map. Larger scale prints will be used to delineate these vegetation associations.

GRAPH I. SNOWMELT PATTERNS FOR SIERRA-LAHONTAN TEST AREA



(--- indicates missing date)

GRAPH II. SNOWMELT PATTERNS FOR COLORADO PLATEAU TEST AREA



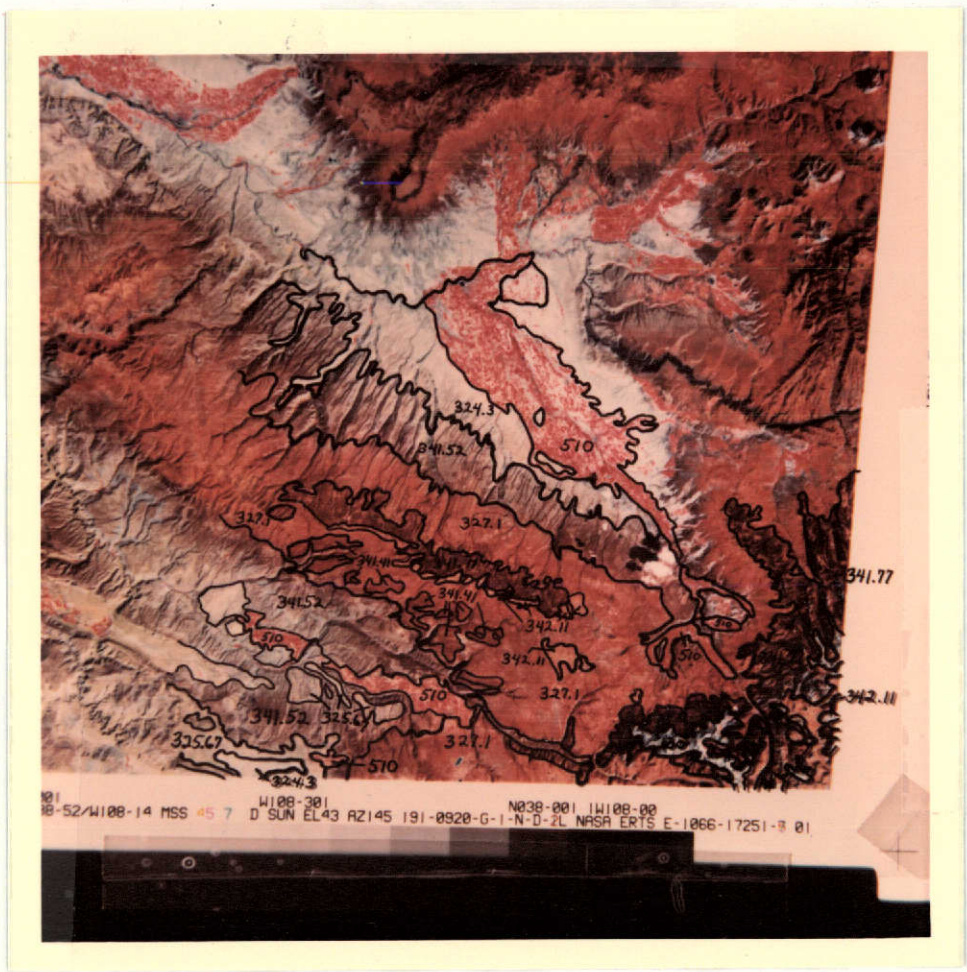


Figure 1. Vegetation types from ERTS 1:1000000 Imagery, Uncompahgre Plateau, Colorado.

325.67 - big sagebrush (Artemisia tridentata) shrublands.

327.1 - broadleaf shrublands dominated by Gambel's oak (Quercus gambellii) and other shrubs (Symphoricarpos, Amelanchier, Juniperus). Inclusions of meadows, aspen stands, and mixed coniferous forest species are identifiable on larger scale ERTS imagery but are too small to map.

341.41 - ponderosa pine (Pinus ponderosa) forests.

341.52 - pinyon pine/Utah juniper (Pinus edulis/Juniperus osteosperma) woodlands. Density differences and perhaps understory components can be identified on larger scale ERTS imagery.

341.77 - spruce-fir (Picea engelmannii - Abies lasiocarpa) forests. Where extensive areas are mixed with aspen a different color is observed.

342.11 - aspen (Populus tremuloides) forests.

510 - field crops.

Within all of these types are riparian vegetations that vary with altitude and are identifiable on ERTS imagery. These types (not mapped due to their narrow habitats) include poplar (Populus spp.) in lowlands, Picea pungens/ Salix spp. in intermediate elevations, and Salix spp./Alnus spp. types in the mountains and subalpine areas.

Rice Analog Studies

California Section: Interpretation testing procedures have been partially established. In the California rice area we have chosen as our primary sampling site the entire agricultural area of the Northern Great Valley. This area of approximately 10,000 square miles has been delineated on ERTS-1 mosaics. This small-scale imagery will be subjected to multispectral and multidate interpretation in order to indicate the usefulness of the ERTS-1 images (1) for identifying agricultural crop land from non-agricultural land, (2) for identification and differentiation of rice from all other crops, and (3) for compilation of the rice crop acreage. NASA-prepared

color products are not available for current dates but use of an additive color viewer and early season ERTS coverage has allowed preliminary analysis. From these preliminary analyses we have determined that it is possible to identify and delineate the rice fields with a high degree of accuracy. A multidate enhancement technique using data tapes separated by exactly one year to obtain similar stages of rice development has indicated an increase in rice crop acreage in the 1973 season. This apparent increase in acreage is now being quantified and will be compared with ASCS rice allotment figures to determine correlations.

Located within the primary test area are the subsampling units. These four areas of approximately 40 square miles have been monitored throughout the 1973 season by large-scale aerial photography and ground data acquisition. Within these subsample units are farms. These high-resolution cells will be the base for extensive photo interpretation dealing with crop condition monitoring and will provide highly controlled conditions for comparison with the ERTS-1 imagery for all phases of interpretation. Definitions of the types of data needed for proper statistical validity are being made and procedures to extract these types of data are being established.

Louisiana Section: Due to consistent cloud cover, ERTS-1 data and RB-57 coverage is very minimal. When the needed imagery is received at the EarthSat office, procedures identical to those used for the Northern Great Valley test site will be applied. We continue to monitor this area according to our study plans.

PLANS FOR NEXT REPORTING PERIOD

The ecological legend will be completed to quaternary levels for all natural vegetation (300) and cultural vegetation (400) types.

Preliminary photo interpretation tests of I^2S color reconstituted frames of the Sierra-Lahontan test site and Colorado Plateau test site will be conducted. These tests will provide some indicator as to what level and with what accuracy analogous vegetation types can be identified on ERTS.

Vegetation mapping will be accomplished in each test area and compared with existing vegetation maps and ground data to determine the usefulness of ERTS imagery for forest natural resource inventories.

Selected analogous and non-analogous vegetation types will be characterized on color reconstituted images on a multidate basis. This information will then be correlated with ground truth phenological data and snowmelt data.

PROBLEMS

A partial shipment of color composite prints and transparencies has been received from NASA for the natural vegetation analog study. Color balance was too variable to be useful in an inter-regional analysis of specific vegetational-environmental features. For example, Figure 2 shows color transparency copies of two ERTS color prints. The scenes are identical (Colorado Plateau, 27 September 1972, 4-5-7 color composite, ERTS E-1066-17251). The difference is that the frame marked by "A" was received on August 29, 1973 from Sioux Falls while the frame marked by "B" was received June 3, 1973 on a separate order from the same laboratory. The color values (I.S.C.C.-N.B.S. system) of the areas marked are 37-medium orange red for "B" and 30-deep yellow pink for "A."

To attempt a comparison of various vegetation types with known analogs in the Sierra-Lahontan area is impossible. The entire order has been reordered with strict color balance control requested. This delay hampers attempts to

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conduct inter-region testing and other analyses until the color products with necessary color fidelity can be delivered.

PERSONNEL

No change in personnel has occurred since the last reporting period.